

## Vaccine fatigue: the danger of measles

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March 10, 2009

**In 1963, the first vaccine for measles appeared. At that time, measles was a common childhood disease, infecting – alone in the United States - 3 to 4 million individuals each year, causing some 50,000 hospitalizations, 1000 permanent disabilities and 400–500 deaths. The measles vaccine had an immediate impact, steadily reducing the incidence and mortality of the disease in Western countries. In 2000, the United States was declared free of endemic measles, and Europe has set the goal to be measles-free by 2010. Another vaccination success story! So it seemed. Measles is making a comeback, causing an increasing number of outbreaks over the last few years. And with less than 80% immunization coverage in some countries, an epidemic may not be far away.**



Measles control, an ambitious goal: 2 shots, 95% vaccination © Holger Klimek

### Measles (rubeola)

also referred to as “red” or “hard” measles (distinct from the “German measles” or rubella)

- caused by a paramyxovirus (genus Morbillivirus), an enveloped, single-stranded, negative-sense RNA virus
- spread through droplets produced by coughing or sneezing
- incubation period (from infection to symptoms) typically 10–12 days
- symptoms include fever, cough, runny nose, red eyes (conjunctivitis)
- characteristic maculopapular (macule=spots, papule=bumps) rash appears 3–5 days after the fever starts
- contagious up to 4 days before symptoms, 3–5 days after rash develops
- complications appear in ~30% of measles cases and include diarrhea (8%), ear infections (7%), pneumonia (6%), blindness (1%), acute encephalitis (0.1%); acute encephalitis is deadly in ~15% of patients that develop it

In comparison to many other vaccine-preventable diseases, for example polio or smallpox, measles is highly contagious; among unimmunized individuals exposed to the virus, 90% will catch it. An extremely high vaccination rate – approximately 95% according to a World Health Organization (WHO) estimate - is therefore required to effectively contain the disease. Unfortunately many countries, even those with ample resources, are far away from this goal.

## To immunize or not to immunize ...

That is a question occupying the thoughts of many parents. In most countries, vaccination is recommended but not mandatory, and for a variety of reasons – be it religious or philosophical considerations or medical safety issues – some parents choose to refuse or delay vaccination of their children. Another factor is that the vaccines targeting common childhood diseases have been so effective that the diseases are no longer common; many people of childbearing age have never seen a case of measles, mumps & Co. When the benefit of vaccination is perceived to be lower than the risk, many people refuse immunization.



Measles rash on a child's back. © CDC

Efforts to control measles in many Western countries suffered a setback following a 1998 report that the MMR (Measles-Mumps-Rubella) vaccine is linked to autism (Wakefield et al. *The Lancet* 351: 637–661); in England the MMR vaccination rates dropped from 95% to 80% (and only ~60% in some parts of London). Public confidence in the vaccine is slowly returning after numerous subsequent studies have failed to confirm the link, but an estimated three million children (~25%) in the UK are missing at least one of the two MMR doses recommended for full immunity (15% don't respond to the first shot). The result: 2008 had the highest number of measles cases (1,348) reported for 13 years, and measles was declared to be again endemic in the United Kingdom. The British Health Protection Agency (HPA) has warned that unless vaccination rates increase significantly, there is a real threat of an epidemic of between 30,000 to 100,000 measles cases.

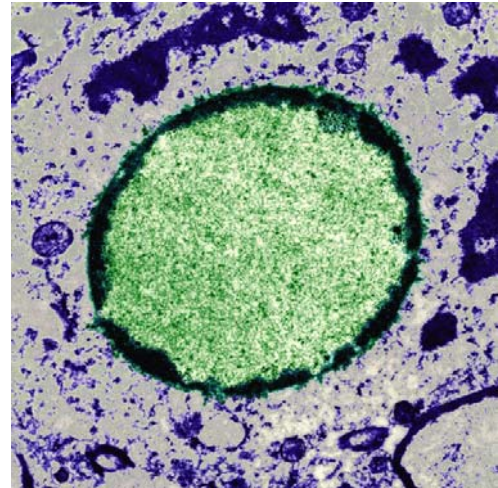
Measles has also hit other European countries hard. In February of this year, the WHO European office reported that 8145 measles cases were reported over the previous 12 months, with 86% of the cases coming from Austria, Germany, Italy, Spain, Switzerland, the UK and Israel. Switzerland has been particularly hard; an ongoing outbreak that started in 2006 peaked in March 2008, with 2195 cases reported that year (approximately 14 measles cases per 100,000 inhabitants; in contrast, the UK registered 1.6 cases per 100,000 people). The virus strain from Switzerland, which is thought to have originated in Japan, caused further outbreaks in Germany, Austria and Norway.

## It's just a plane ride away ...

Global travel is a real challenge for sustained control of measles and other infectious diseases. For example, among the 131 measles cases reported in the United States between January and July of 2008, 17 were directly “imported” (US travellers or foreign visitors), and an additional 99 could be linked to importations. Many of the cases were tightly clustered; although the requirement for immunization before children can start school has boosted vaccination rates in the US to 92–98%, most states allow exemptions on religious grounds, creating pockets of unimmunized individuals that are very conducive to outbreaks. The high overall immunization rate in the US has prevented the spread of these outbreaks. However, in states such as Colorado, where

exemptions through parental choice are allowed, rates have dropped to 75% (Switzerland reports 78% immunization).

In the recent measles outbreaks, most cases were in unvaccinated or incompletely vaccinated children, but many babies and some vaccinated individuals were also infected. The presence of too many unimmunized people in a population disrupts “herd immunity”, posing a danger to individuals who cannot be immunized such as those with a medical condition or infants who haven’t been immunized but are no longer completely protected by maternal antibodies. In addition, studies have shown for measles and pertussis that a rise in the number of unimmunized individuals increases the risk that vaccinated children also become infected.



Measles infection in a brain cell nucleus © Mike Kayser, Wellcome Images

### Measles is not alone...

Other vaccine-preventable infectious diseases we shouldn’t forget:

**Pertussis (whooping cough):** This severe and highly contagious bacterial disease is endemic in Canada, causing 2000-10,000 deaths per year, and is the only vaccine-preventable disease associated with increasing deaths in the USA. Teens and adults that have lost immunity (5-10 years after vaccination) can become infected and pass it to newborns.

**Mumps:** Causes periodic outbreaks in North America and Europe, with a particular fondness for university campuses.

**Diphtheria:** A leading cause of childhood death in the prevaccine era, it staged a major comeback between 1990 and 1995 the former Soviet Union (>140,000 cases and >4000 deaths reported.) Immunity wanes, so vaccination every 10 years is needed.

**Polio:** In 1992–1993, imported poliovirus caused 71 illnesses and 2 deaths in an unimmunized community in the Netherlands.

Although measles is causing trouble in the developed world, it is not a disease of the developed world; measles infection causes much more havoc in developing countries.

## Measles on a global scale

The WHO estimates that measles caused 197,000 deaths in 2007. This is a huge number but a dramatic decrease from previous years: between 2000 and 2007, massive vaccination efforts decreased global measles deaths by 74%, and mortality was reduced by 90% in the eastern Mediterranean and Africa. The WHO and UNICEF (United Nations Children's Fund) have the goal to reduce global measles deaths by 90% by 2010.

It won't be easy; in the developing world immunization is very often subject to the whims of conflict and politics. Take Nigeria, a perfect example of how the advances made today might be reversed tomorrow: in the early 2000s, religious and political leaders, suspicious of Western medicine, advised followers not to be immunized with the polio vaccine. The disease quickly reappeared in former disease-free areas, and Nigeria now accounts for 50% of polio cases worldwide. Extended to other vaccines, this wariness has also led to major outbreaks of measles and diphtheria.



Global efforts have reduced measles deaths by 90% since 2000. Next goal, eradication?  
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While experts generally agree that the goals for measles reduction set for 2010 are out of reach, there is nevertheless still talk of eradication of measles. If eradication of polio is successful, measles is most likely the next in line. Are we up to the challenge?

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## References and further reading

- An explanation of herd immunity can be found on Wikipedia
- The risk to vaccinated children with increasing numbers of unvaccinated individuals was reported in:
  - Salmon DA *et al.* Health consequences of religious and philosophical exemptions from immunization laws: individual and societal risk of measles. 1999. *JAMA* 282: 47–53.
  - Feikin DR *et al.* Individual and community risks of measles and pertussis associated with personal exemptions to immunization". 2000. *JAMA* 284: 3145–3150.
- A thorough review entitled “Measles Control and the Prospect of Eradication” was published by W.J. Moss in *Current Topics in Microbiology and Immunology* (2009) 330: 173–189.